

year, and with about the same degree of richness, precisely as in the case of the August meteors, or Perseides, whence we can understand the great interest attaching to the study of these objects during the next few years, for the purpose of tracing the law according to which the progressive diminution of these displays proceeds, especially if we remember (as Prof. Schiaparelli, of Milan, has pointed out to me), that a fine shower was observed in 1818, that is to say, nearly midway between the great displays of 1799 and 1833.'

A General Comparative Table of Radiant-Positions and Duration of Meteor-Showers. By R. P. Greg, Esq., F.R.A.S.

The accompanying Table of Radiant-Positions and Epochs of Meteor-Showers is intended to show at a glance the comparative results of all the meteoric showers whose centres of radiation, in right ascension and north declination, and whose epochs have hitherto been approximately or definitely ascertained. The recent increased interest attached to meteoric science since Professor Schiaparelli's discovery of the intimate connexion between the orbits of comets and meteor-rings renders it most desirable that the scattered and laborious researches of various observers and collators should be brought together and synoptically arranged. This I have endeavoured to do in as brief and simple a manner as possible. Having due regard to the nature of the case, there results a greater amount of coincidence and resemblance than might have been expected from the reductions of nearly 6000 observations, independently of Leonides and Perseides, made by different observers in different countries, recorded during the last twenty years. Indeed the results are frequently remarkably coincident, when we consider how difficult it is to arrive, even in the case of the more frequently observed and better known Leonides and Perseides, at a precise radiant-point. It is even less simple to ascertain with anything like precision the extent and configuration of the radiant area when, as is frequently the case, it more or less diffusely occupies a region amongst the stars of some 10° or 20° in diameter. In some cases it is highly probable that the area is simply "diffuse;" in others it probably includes a series of minor or sub-radiants (the existence and origin of which have been ingeniously, and perhaps correctly, explained by Signor Schiaparelli*), and of whose existence I had myself expressed a suspicion, some years ago, in the Report of the British Association for 1868-9. The probability of the existence, also, of meteoric showers having a duration of some six weeks appears to be still further confirmed by the comparative table or catalogue now presented. (See *Proceedings of the British Meteorological Society* for January 1865.) Professor Heis (see the *Astronomische Nachrichten*, April 1867) was the first systematically to attempt to group and arrange centres of

* See the Report of the British Association Committee on Luminous Meteors, 1871.

radiation for meteor-showers, as deduced from a series of many hundreds of observations recorded and mapped by himself and pupils at Münster, in Westphalia; but he did not attempt to fix the exact duration, or radiant-position, of individual meteor-showers, or the relative importance of the different meteoric systems. Messrs. Greg and Herschel attempted to do this more systematically, both from special observation and by a reduction of some 2000 meteors recorded in the annual Meteor Reports and Catalogues of the British Association (see the vols. of the British Association Reports for 1864, and 1868-70). The results were also laid down in a series of 22 folio plates upon an atlas of the stars gnomonically projected. In addition, a number of new radiants were also determined by myself, deduced from some 700 Italian observations observed and described by Signors Zezioli, Denza, and Serpieri, during the years 1868-1870; and many of the English ones were found to be fairly well confirmed by the Italian observations. The catalogue of meteor-radiants lately published by Schiaparelli, chiefly and specially deduced from some 900 (out of nearly 7000) observations made in the course of three years, 1867-1869, by the late indefatigable observer Signor Zezioli, of Bergamo, was drawn up with the more special view of tracing out the specific centres of radiation of various separate or identical meteor-showers, and their possible daily alterations of position. The result seems frequently to confirm a number of the radiants of Professor Heis and of Messrs. Greg and Herschel, and to indicate more clearly the probable occurrence of subordinate or multiple radiant-points belonging to one and the same meteor-system. (See the British Association Reports, 1871, p. 44, *et seq.*) It may also be here noted that the Italian observations, generally more consecutively and regularly conducted, include, necessarily, a far larger proportion of small meteors, of 4th and 5th magnitudes, than could be the case with the English and German ones; and also that, though including a greater number of probable meteor-showers of minor and secondary importance, these nevertheless possess features of much scientific interest. Probably the catalogue of radiants given by Messrs. Greg and Herschel show best the general positions, epochs, and durations of the more prominent showers; but much has yet to be done, doubtless, in more precisely and accurately determining those features. The very considerable number of centres of radiation, combined with the frequent, and evident tendency to width and diffuseness in some of the radiant areas themselves, combine to make the reductions and grouping of the paths, or meteor-tracks, for any single radiant, on celestial maps especially constructed for the purpose, often a matter of considerable complexity and difficulty. Mr. Greg thought at first that there was a not unfrequent tendency, in long-enduring showers, to give a radiant advancing with the time among the stars; but though, undoubtedly, the radiant area frequently appears to have an elongated form, further investigation does not seem to bear out that idea. Possibly the radiants M 6, 7, M 7, 8, S 5, 6, 7, 8, however, are exceptions. Signs of elongation of the radiant area

are considered by Mr. Greg, Signor Serpieri, and Professor Newton to be more or less plainly noticeable in the principal meteor-showers of August, November, and December. Some short-lived showers, or those having days of special maximum, as K 1, 3, O, L (the November shower), and Q H 2, however, appear to have a very fairly precise centre of radiation. The radiant points by Prof. Schiaparelli are those given by Dr. G. von Boguslawski, of Stettin, in his recent German publication of a new edition (considerably enlarged by the author), of Schiaparelli's work on the *Astronomical Theory of Shooting Stars*. The 189 radiants there given are, in this Table of Comparisons, reduced by grouping to 79, and the grand total of the radiants now presented is 132. It is, however, probable that a certain number of these are either pseudo-centres or require further confirmation or correction. In some cases, probably, the truest radiant-positions may be found in a more or less nearly average position of those given by two or three of the catalogues now for the first time fully and systematically tabulated and arranged together. In several cases, as with U, B 5, R G, E 2, Y, H, of Greg and Herschel, some of them representing very well-marked and important meteor-showers, the position and epoch given by Greg and Herschel are certainly more accurately placed and determined than those of their counterparts in the other lists. For certain showers, as L, A 10, Q H 1, V, T 1, Q H 2, O, G 1, K 1, 3, A G 1, S 4, S G 2, U, F 1, 2, L H, &c., there are pretty well established days of maximum frequency, giving meteors more or less characteristically distinguished from those of other showers. Some of these distinctions or peculiarities have been attempted to be given with the Atlas published by Messrs. Greg and Herschel for the British Association in 1868, but more observation specially directed to these points is required. It is yet too early to attempt to give results of a comparison of the list of radiant-points with the orbits of comets; but it is well known that some successful attempts in this direction have been already made by Schiaparelli, Weiss, Galle, Newton, and D'Arrest. The first and most important object at present attempted to be gained is to collect all the best observed radiant-positions and epochs of the meteoric showers themselves, and to ascertain, by special and further observation, with as much accuracy as possible, their true positions and durations. With the view to assist these determinations, and to enable observers to arrive at uniformity in the method and arrangement of their results, it is hoped that the accompanying Table will be found to be of some utility, as representing, principally for the northern hemisphere, the limits to which this branch of observations in meteoric astronomy may be briefly and comprehensively described as having at present reached. In most cases positive accuracy is impossible, from the very nature of the case, absolute accuracy of observation of the meteors themselves being unattainable; nor, in many cases, is it probable that the exact average centre of radiation of a number of meteors will be quite similarly determined by two different collators, even from the same series of observations.

A Synoptic or General Table of the Radiant Positions and Duration of Meteor Showers, observed in the Northern Hemisphere, 1872.

Epoch or Duration of Meteoric Shower. (A.D. Greg.) No. 1872.	Average Position of Radiant. R.A. N.D.	Name or Number of Radiant.	Observations.	
			(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)	
1 Dec. 20—Feb. 26	10° 86°	N G	G. & H.	Radiant elongated 20°, +88° to 320°, +80°. Centre 350°, +87°?
Dec. 15—Feb. 14	222 87	N 21, 1, 2, 3	Heis	
2 Dec. 27—Jan. 31	130 47	189, 7, 23	S. & Z.	Centre about 135°, +45° = Comet of 1680? (Weiss).
Jan. 1—Feb. 9	135 40	M 1, 2	G. & H.	
Jan. 1-15	145 51	M 1	Heis	
3 Dec. 27—Jan. 29	203 53	{ 1, 6, 12, 13, 16, } 18, 21, 188	S. & Z.	Radiant multiple.
Jan. 6-29	200 55	Z 10	G. & H.	
4 Jan. 2-3	238 45	K 1, 3	G. & H.	Corroborated by American observations. A notable meteor epoch, maximum 2nd-3rd Jan.
Dec. 15—Jan. 15	231 53	K 1, 3	Heis	
5 Jan. 10	10 57	3	S. & Z.	Probable centre near 22°, +56°.
Dec. 20—Jan. 30	21 56	A 1, 2	G. & H.	
Dec. 15—Jan. 31	32 56	A 20, 1, 2	Heis	
6 Jan. 11	47 40	4	S. & Z.	
7 Jan. 6	150 67	G ₂	G. & H.	(Noticed by Mr. Clark, at York, 1872.) Possibly = No. 132.
8 Dec. 22—Feb. 6?	181 35	2, 5, 30, 185, 186	S. & Z.	
Jan. 1-25	183 36	M G 1	G. & H.	Radiant area large; multiple; real centre at 180°, +35° = Comet II. 1792? (Weiss). Heis probably incorrect.
Jan. 16—Feb. 1	169 45	M 2	Heis	
9 Jan. 19—Feb. 5	209 25	9, 14, 15, 27	S. & Z.	Radiant multiple?
10 Jan. 27	132 67	17	S. & Z.	Centre about 140°, +70°?; diffuse, and rather uncertain.
Jan. 21—Mar. 20?	140 71	M 4, 5	G. & H.	
11 Jan. 28	67 25	19	S. & Z.	Denza found 72°, +18°.
Dec. 20?—Feb. 6	65 20	A G 1	G. & H.	
12 Jan. 3—Mar. 16	143 -7	S 1, S G 1	G. & H.	
13 Jan. 9-19	72 4	G ₃	G. & H.	Reduced from Denza's obs. 1868, by Mr. Greg, and confirmed in England.
14 Jan. 19—Feb. 6	242 63	11, 29	S. & Z.	(223°, +54°, by Mr. Greg, from Denza's observations.) Centre 225°, +54°.
Jan. 29—Feb. 6	223 54	K 2	G. & H.	
Jan. 15-31	227 54	K 2	Heis	

The initials S. & Z., refer to Prof. Schiaparelli and Sig. Zezioli (1867-1870); G. & H., to Mr. Greg and Prof. Alex. Herschel (British Association, 1848-1871); Heis, to Prof. Heis, of Münster (1839-1867). The Nos. under "Name or Number of Radiant," to Boguslawski's Catalogue in the translation into German of Signor Schiaparelli's work on meteors.

Epoch or Duration of Meteoric Shower.	Average Position of Radiant.	Name or Number of Radiant.	Authority.	Observations.
				(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
15 Jan. 18 — Feb. 13	226 $^{\circ}$ 30	$\{ 8, 10, 20, 22, \}$ $\{ 24, 25, 33 \}$	S. & Z. G. & H.	Radiant multiple; centre $230^{\circ}, +32^{\circ}$.
Jan. 28-29	233 $^{\circ}$ 34	Q Z		
16 Feb. 1-14	61 $^{\circ}$ 46	A 3	Heis	
17 (34) Feb. 6	183 $^{\circ}$ 56	31	S. & Z.	Probable commencement of M 7
Feb. 1-28	172 $^{\circ}$ 59	M 3, 4	Heis	of Heis.
18 Feb. 16	74 $^{\circ}$ 48	39	S. & Z.	
Feb. 9-17	73 $^{\circ}$ 40	A 3, 4	G. & H.	= A Z 3; centre $73^{\circ}, +40^{\circ}$. Radiant precise.
Feb. 15-28	76 $^{\circ}$ 40	A 4	Heis	
19 Feb. 6-15	131 $^{\circ}$ 52	28, 37	S. & Z.	Requires further investigation.
Mar. 1-15	120 $^{\circ}$ 54	M 5?	Heis	Radiant elongated according to Schiaparelli.
20 Mar. 1-15	50 $^{\circ}$ 47	A 5	G. & H.	Confirmed by Italian obs.
Feb. 1 — Mar. 15	50 $^{\circ}$ 49	A 5	Heis	
21 Feb. 3	153 $^{\circ}$ 21	26	S. & Z.	
Feb. 4-26	153 $^{\circ}$ 35	M 3	G. & H.	
22 (31) Feb. 10 — Apr. 2	175 $^{\circ}$ 10	S 2, 3	G. & H.	This series of radiants (S. of Heis)
Feb. 15 — Mar. 31	177 $^{\circ}$ 13	S 1, 2, 3	Heis	seen by Neumayer in Australia, probably advances from R.A. 175 to R.A. 200, with the time.
23 Feb. 11-20	194 $^{\circ}$ 15	S 2, a	G. & H.	Possibly a continuation of No. 14.
24 Feb. 17-19	238 $^{\circ}$ 51	40, 41	S. & Z.	Meteors small.
25 Feb. 13	133 $^{\circ}$ 26	32	S. & Z.	Ditto.
26 Feb. 14	105 $^{\circ}$ 62	34	S. & Z.	Ditto.
27 Feb. 14	263 $^{\circ}$ 68	36	S. & Z.	Ditto.
Feb. 15-28	245 $^{\circ}$ 76	N 4?	Heis	
28 Feb. 14-15	209 $^{\circ}$ 52	35, 38	S. & Z.	Ditto.
29 Mar. 1-15	50 $^{\circ}$ 49	A 5?	Heis	
30 Mar. 3-25	247 $^{\circ}$ — 3	S Z 1	G. & H.	Possibly commencement of S Z 2.
31 (47) Mar. 5-17	190 $^{\circ}$ 1	S 4	G. & H.	Probable commencement of S 5, 6.
32 Mar. 9-27	74-112 32-47	A Z 1, 2, 3	G. & H.	In part = A 3, 4 radiant contd.? Small meteors obsd. by Zezioli:
				A Z 1 = $112^{\circ}, +32^{\circ}$
				A Z 2 = $98^{\circ}, +46^{\circ}$
33 Mar. 20 — Apr. 25	143 $^{\circ}$ 51	43, 61	S. & Z. G. & H.	A Z 3 = $74^{\circ}, +47^{\circ}$ = A 3, 4? Central position $148^{\circ}, +48^{\circ}$; perhaps connected with M Z.
Mar. 22 — Apr. 23	146 $^{\circ}$ 46	M Z		
Mar. 16-31	150 $^{\circ}$ 47	M 6		
34 (17) Mar. 17	186 $^{\circ}$ 56	42?	S. & Z. G. & H.	Probable continuation of M 3, 4 of Heis. Centre $180^{\circ}, +50^{\circ}$.
Mar. 3 — Apr. 30	180 $^{\circ}$ 60	M 6, 7		
Apr. 1-15	180 $^{\circ}$ 49	M 7		

Epoch or Duration of Meteoric Showers.	Average Position of Radiant.	Name or Number of Radiant.	Authority.	Observations.
				(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
35 (50) Apr. 1-23	256 43	{ 46, 49, 50, 51, } 57, 60	S. & Z.	Multiple radiant. Possibly commencement of D G 2. General centre of D G 1, D G 2 = $268, + 51^{\circ}$ (See No. 50).
Mar. 11—Apr. 23	267 53	D G 1	G. & H.	
36 Mar. 27—Apr. 30	224 38	44, 48, 54, 65	S. & Z.	
Mar. 12—Apr. 30	223 40	M G 2	G. & H.	
37 Mar. 15—Apr. 20	305 27	W Z	G. & H.	
38 Apr. 25	260 24	63	S. & Z.	Prof. Herschel, 13 April, 1864, $= 273^{\circ}, + 25\frac{1}{2}^{\circ}$ = Comet I. 1861?
Mar. 15?—Apr. 23	268 25	Q H 1	G. & H.	(Weiss). Max. 13th April. R. P. Greg, 20th April, 1872, $267^{\circ} + 25^{\circ}$
39 Mar. 19?—Apr. 22	277 $\frac{1}{2}$ 34 $\frac{1}{2}$	Q H 2	G. & H.	Prof. Serpieri ($267^{\circ}, + 35^{\circ}$). Prof. Galle ($278^{\circ}, + 34\frac{1}{2}^{\circ}$) = Comet I. 1861? (Weiss and Galle). A notable shower; max. display April 19-22. Q H 1, Q H 2 and C, probably all identical.
Apr. (20) 15-31	277 38	C	Heis	
40 Mar. 20—May 29	227 -5	S G 2 (S Z 2)	G. & H.	
41 Mar. 25—Apr. 30	290 -10	O Z	G. & H.	More observations required.
42 Apr. 11-29	187 24	53, 64	S. & Z.	
Mar. 25—Apr. 24	198 32	M G Z	G. & H.	
Apr. 1-30	192 18	S 4, 5	Heis	
43 Mar. 30—Apr. 14	210 54	45, 47, 55, 59	S. & Z.	Prof. Serpieri, 1869 ($202 + 62$).
Apr. 25—May 25	202 52	{ M 7, 8?, M 6, } 7 continued	G. & H.	This radiant appears to advance with the time, and is a continuation of M 6, 7; lasting ten weeks?
44 Apr. 10-14	165 47	52, 56	S. & Z.	
Apr. 15-30	160 49	M 8	Heis	
45 Apr. 14	240 55	58	S. & Z.	
46 Apr. 25	256 75	62	S. & Z.	
Apr. 10—May 4	70 87	N 8?	G. & H.	Radiant, well defined near <i>Polaris</i> .
Apr. 1-30	267 84	N 7, 8	Heis	
47 (31) Apr. 2—May 4	194 9	S 5, 6	G. & H.	Radiant elongated, 189° to 200° , R. A.; and 5° to 12° Dec. = S. 5, 6, 8?
48 Apr. 29—June 12	123 40	M G 4	G. & H.	
49 (53) Apr. 19-20	152 22	M 3 Z	G. & H.	{ (Perhaps commencement of Y?) Elongated radiant?
50 (35) May 25	280 54	74	S. & Z.	
Apr. 23—May 31	270 55	D G 2	G. & H.	Well-defined radiant and shower; continuation of D G 1 possibly.
51 May 22—July 5	240 24	70, 83, 87	S. & Z.	A well-marked shower. Radiant centre at $239^{\circ} + 23^{\circ}$, and probably multiple. Duration nine weeks.
Apr. 12—June 30	240 25	Q 1, 2	G. & H.	β <i>Herculis</i> in April; and possibly distinct from position in corona for June.
May 1—June 30	237 19	Q 1, 2	Heis	
52 Apr. 27—June 30	305 81	N 9, 10	G. & H.	Radiant well defined.
May 1-31	236 81	N 9, 10	Heis	

Epoch or Duration of Meteoric Shower.	Average Position of Radiant.	Name or Number of Radiant.	Authority.	Observations.
				(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
	R.A. ° °			
53 (49) Apr. 29 — May 15	163 12	Y	G. & H.	{ (= M 3, Z?) Radiant elongated, 160° to 167° R.A., and 75° to 70° Dec.
54 (47) Apr. 2 — May 4 May 1-31	195 7	S 5, 6, 8	G. & H.	{ Probably a continuation of S 4, 5.
	202 9	S 6	Heis	{ Radiant elongated?
55 (62) May 1-31	325 55	B 1	Heis	{ Probably commencement of No. 62 or 65.
56 May 18 — June 14 May 6 — June 30	273 34	68 (?), 75, 79	S. & Z.	{ Radiant elongated? centre at
	280 29	W	G. & H.	{ $270^{\circ} + 32$ (No. 68 doubtful.)
57 May 2 — June 20 June 28	312 21	W G	G. & H.	Radiant elongated.
	302 27	82?	S. & Z.	
58 May 2 — June 9	206 39	66, 72, 78	S. & Z.	{ Small meteors; probably a multiple radiant.
59 May 16 — June 2	235 43	67, 71, 77	S. & Z.	Ditto.
60 May 22-24	301 37	69, 73	S. & Z.	Ditto.
61 May 26	237 59	76	S. & Z.	Ditto.
62 (55) June 1-30	333 42	B 2	Heis	{ (= B 1 of Heis continued?) Doubtful.
63 June 7 — Aug. 12? June 1-30	294 3	Q G	G. & H.	{ = Neumayer and Heis Ξ radiant?
	292 15	W	Heis	{ Radiant well defined at $294^{\circ} + 7^{\circ}$. Ξ 2 for July at $305 + 5$.
64 June 1-29	168 55	M G 3	G. & H.	{ Radiant rather uncertain, more observations needed.
65 July 18-31 June 11 — July 11 July 1-31	320 62	{ 94?, 101, 102, 107, 114?, 127 }	S. & Z.	{ Multiple radiant. Radiant precise.
	315 60	B 1	G. & H.	
	317 62	B 3, 4	Heis	
66 June 28 — Aug. 3	270 51	{ 81, 90, 95, 97, 121, 131 }	S. & Z.	{ Confirmed in 1872 by Miss Herschel at $274^{\circ} + 57^{\circ}$.
67 June 29 — Aug. 24	330-345 14	T 1	G. & H.	{ Requires further investigation; and possible connexion with Nos. 76 and 88. At $345 + 15$ in 1871, A. S. Herschel. Radiant elongated.
68 (80) June 19? — Aug. 4	304 40	{ 80?, 86, 88, 92, 109?, 112, 116, 117, 120, 126, 133 }	S. & Z.	
	310 47	B 4	G. & H.	{ Heis B. 6, doubtful. Clark at York gives the position at $315^{\circ}, + 42^{\circ}$.
	304 59	B 6?	Heis	
69 July 4	3	84	S. & Z.	
	12	70	G. & H.	{ Radiant diffuse; elongated?
70 July 5	222 60	85	S. & Z.	{ Serpieri; 11 July, 1868 = $200^{\circ}, + 55^{\circ}$, centre $216^{\circ}, + 57^{\circ}$? Confirmed by Zezioli's observations.
	210 55	M G 5	G. & H.	
71 July 2 — Aug. 16? July 8 Aug. 1-15	280 65	B 3	G. & H.	
	288 64	89	S. & Z.	{ Heis, position doubtful.
	297 68	B 5	Heis	

Epoch or Duration of Meteoric Shower.	Average Posi- tion of Radiant.	Name or Number of Radiant.	Authority.	Observations.			
				R.A.	N.D.	(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z" by Mr. Greg, from Zezioli's Observations).	
72 (51) July 4 — Sept. 12	248° 18'	122, 124	Q. 3	Radiant rather diffuse, and elongated? Heis incorrect?	Heis	{ Radiant rather diffuse, and elongated? Heis incorrect?	
July 1-15	262 12	Q 3	G. & H.				
73 July 4-11?	210 20	Q 4	G. & H.	{ Confirmed also by Zezioli's obs. and reduced by Mr. Greg.		{ Confirmed also by Zezioli's obs. and reduced by Mr. Greg.	
74 July 16	257 36	Q H	G. & H.	Observed by Prof. Herschel, July, 1871. Perhaps = Q 3.			
75 (93) July 24 — Aug. 11	330 88	115, 135?, 143	S. & Z.	Radiant well defined, close to <i>Polaris</i> . At $10^{\circ} + 83$ in 1871.	Heis	{ Radiant well defined, close to <i>Polaris</i> . At $10^{\circ} + 83$ in 1871.	
July 28 — Sept. 10	359 90	N 12, 13	G. & H.				
July 1 — Aug. 31	220 85	N 11, 12, 13, 14	Heis				
76 July 18 — Aug. 4	344 40	{ 98, 100, 103, 104, 106, 113, 123, 134	S. & Z.	Radiant multiple. Centre group near η <i>Pegasi</i> ; at μ <i>Pegasi</i> in 1872.	G. & H.	{ Radiant multiple. Centre group near η <i>Pegasi</i> ; at μ <i>Pegasi</i> in 1872.	
Aug. 3-15	337 25	T G	G. & H.				
77 July 2 — Aug. 16	342-34	H	G. & H.	{ = Y ₁ of Neumayer and Heis. Southern Hemisphere radiant near <i>Fomalhaut</i> , observed by A. S. Herschel, 28 July, 1866. Also seen in England, Aug. 9-11 1871.			
78 July 11 — Aug. 7	7 50	{ 93, 111, 129, 130, 138	S. & Z.	From Zezioli's obs. (A. 9). Possibly with R 1, 2 of G. & H.	G. & H.	{ From Zezioli's obs. (A. 9). Possibly with R 1, 2 of G. & H.	
July 4-11?	7 42	A 9	G. & H.				
79 July 28	174 55	118	S. & Z.	{ A well-defined radiant and meteoric shower, 1860-71. Maximum about 10th of August.		{ A well-defined radiant and meteoric shower, 1860-71. Maximum about 10th of August.	
July 29 — Sept. 6?	165 53	V	G. & H.				
80 (68) July 21	309 40	109?	S. & Z.	Possibly connected with No. 68.	G. & H.	{ Possibly connected with No. 68.	
July 4 — Aug. 22	315 31	B G	G. & H.				
81 Aug. 15-31	314 15	T 1	Heis	{ Heis, position probably incorrect.		{ Heis, position probably incorrect.	
82 July 30 — Aug. 4	33 34	125, 132	S. & Z.				
83 July 9-21	242 68	91, 96, 108?	S. & Z.	Radiant well defined.	G. & H.	{ Radiant well defined.	
July 12-31	245 64	B Z	G. & H.				
84 July 21	11 38	110	S. & Z.	Requires further investigation as to Epoch and duration.	G. & H.	{ Requires further investigation as to Epoch and duration.	
July 28 — Sept. 3?	1-15 36	R 1, 2	G. & H.				
85 Aug. 6-12	45 51	{ 137, 139, 142, 144	S. & Z.	N.B. The Perseids have an elongated radiant area extending from <i>Perseus</i> to <i>Cassiopeia</i> = Comet III. 1862.	Serpieri	{ N.B. The Perseids have an elongated radiant area extending from <i>Perseus</i> to <i>Cassiopeia</i> = Comet III. 1862.	
Aug. 10-12	50-30 49-64		Serpieri				
July 28 — Aug. 15	{ 50-25 50-65 44 56	{ A 10	G. & H.	N.B. The Perseids have an elongated radiant area extending from <i>Perseus</i> to <i>Cassiopeia</i> = Comet III. 1862.	Heis	{ N.B. The Perseids have an elongated radiant area extending from <i>Perseus</i> to <i>Cassiopeia</i> = Comet III. 1862.	
July 15? — Aug. 15	51 55	A 10, 11	Heis				
86 Aug. 6	254 37	136	S. & Z.				
87 Aug. 10	47 18	140	S. & Z.				
88 Aug. 10-11	3 17	(Tacchini)	S. & Z.	Possibly a pseudo-radiant of T and Perseids; or a commencement of T ₂ , 3.	G. & H.	{ Possibly a pseudo-radiant of T and Perseids; or a commencement of T ₂ , 3.	
Aug.	355 18	T 1 a	G. & H.				
89 Aug. 22 — Oct. 15?	359 17	T 2, 3, (4?)	G. & H.	= Σ_2 of Neumayer and Heis, 346 + 3 for Sept.	Heis	{ = Σ_2 of Neumayer and Heis, 346 + 3 for Sept.	
Sept. 1-30	352 10	T 2, 3	Heis				

Epoch or Duration of Meteoric Shower.	Average Position of Radiant.	Name or Number of Radiant.	Authority.	Observations.	
				(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)	
No. 1872, (R. P. Greg)					
90	Aug. 28	340° 65'	94, 145	S. & Z.	Exact duration uncertain. Radiant precise. Perhaps connected with No. 65 or 96.
	Aug. 6-31?	335° 67'	E 1	G. & H.	
91	Aug. 2 — Sept. 25	285° 44'	B 5	G. & H.	Well-marked shower; radiant well defined.
	July 29-31	276° 36'	122, 124	S. & Z.	
92	Aug. 15 — Sept. 30	38° 63'	A 12, 13, 14	Heis	{ G. Forbes, Cambridge, Aug. 10, 1868 = $33^{\circ} + 59^{\circ}$.
13 (75)	Sept. 19 — Oct. 20	10° 88'	N 14	G. & H.	Probably continuation of N 12, 13.
	Sept. 1 — Oct. 15	100° 85'	N 15, 16, 17	Heis	
94	Sept. 6 — Oct. 12	55° 33'	147, 150, 155	S. & Z.	
	Oct. 14 — Nov.?	46° 27'	R 3?	G. & H.	
	Sept. 1 — Oct. 15	48° 34'	R 1, 2, 3	Heis	
95	Sept. 1 — Oct. 15	306° 62'	B 7, 8, 9	Heis	
96	Sept. 5-20	319° 53'	146, 151	S. & Z.	Epoch requires further investigation, perhaps = No. 95.
	Aug. 10 — Sept. 30?	335° 52'	E 2	G. & H.	A well-marked shower in September.
97	Sept. 7-12	60° 65'	148, 149	S. & Z.	
98	Sept. 23	28° 35'	152	S. & Z.	
99	Sept. 6 — Nov. 23?	17° 10'	U	G. & H.	{ A southern radiant. Well observed 27th Sept. 1864, by A. S. Herschel, in Kent.
100	Sept. 28 — Nov. 10	82° 49'	153, 162, 166	S. & Z.	Multiple radiant; centre about $82^{\circ} + 50^{\circ}$. An important and well-defined meteoric shower,
	Sept. 17 — Nov. 24	83-92° 50-55'	F 1, 2	G. & H.	with tendency to advance with the time from $75^{\circ} + 45^{\circ}$ to $90^{\circ} + 54^{\circ}$.
	Oct. 16-31	72° 44'	A 16	Heis	
101	Oct. 1-15	57° 61'	A 15	Heis	
102	Oct. 5	240° 63'	154	S. & Z.	
103	Oct. 21	130° 48'	159	S. & Z.	
	Oct. 3-20	142° 44'	L G	G. & H.	
104	Oct. 13-21	84° 21'	{ 156, 157, 158, 160	S. & Z.	Tacchini, 21st Oct. 1867; radiant $74^{\circ} + 25^{\circ}$. Maxm. 18-21 Oct.
	Oct. 17 — Nov. 13?	90° 15'	O	G. & H.	A well-marked shower; radiant precise at ν Orionis. Maxm. 18-20 Oct.
105	Oct. 23	111° 29'	161	S. & Z.	
106	Oct. 28	110° 70'	163	S. & Z.	
107	Oct. 16-31	205° 85'	N 18	Heis	
108	Oct. 16-31	334° 56'	B 10	Heis	
109	Oct. 16-31	23° 40'	P 1	Heis	A doubtful radiant.
110	Oct. 18-29	283° 43'	B G 6	G. & H.	{ More observations required for this shower.
111	Nov. 10	70° 20'	165	S. & Z.	Mr. Backhouse 4-6 Nov. 1869, radiant = $54^{\circ} + 16^{\circ}$; also observed at Greenwich 13th Nov. 1870 at $55^{\circ} + 25^{\circ}$.
	Oct. 25 — Nov. 21	64° 18'	R G 2	G. & H.	Generally a well-marked shower at α Tauri.
	Nov. 1-15	55° 16'	R 4	Heis	

No. 1872, (R. P. Greg.)	Epoch or Duration of Meteoric Shower.	Average Posi- tion of Radiants.	Name or Number of Radiant.	Authority.	Observations.
					(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, " by Mr. Greg, from Zezioli's Observations.)
		R.A.	N.D.		
112	Oct. 31 — Dec. 12	134°	6°	L H	G. & H.
113	Nov. 9	61	42	164	S. & Z.
114	Nov. 12-13	359	37	168, 170	S. & Z.
115	Nov. 13-15	149	23	L	G. & H. } Leonids identical with Comet Heis } 1866.
	Nov. 13-15	148	24	L	
116	Nov. 23 — Dec. 9	291	53	D G 3	G. & H.
	Nov. 1-15	279	56	D?	Heis
117	Nov. 13-14	33	40		Denza } Observed by Prof. Denza, 1870 (Query pseudo radiant = A 16, P 2, 3 or R 3?)
118	Nov. 13-14	40	60	171	S. & Z.
	Nov. 23 — Dec. 18	45	55	A 16	G. & H. } Connected with R. 3? No. 17 Heis } probably a pseudo-radiant. Requires further investigation.
	Oct. 16 — Nov. 30	46	44	P 2, 3	
119	Nov. 12-17	117	38	169, 172	S. & Z.
120	Nov. 30	17	48	176	S. & Z.
	Sept. ? — Nov. 25?	7-23	54-61	A 14, 15	G. & H. } Radiant probably elongated. Sup- posed by D'Arrest and Wei- Heis } to be connected with Biela Comet.
	Nov. 1 — Dec. 15	17	60	A 17, 18, 19	
121	Nov. 10 — Dec. 9	142	36	{ 167, 173, 177, 178, 181 }	S. & Z.
122	Nov. 13	193	40	No. 122	G. & H. } Observed at Greenwich, 1870 radiant near Cor Caroli. doubtful radiant.
123	Dec. 23	157	64	187	S. & Z.
	Nov. 4 — Dec. 19	160	71	K G	G. & H. } Radiant elongated $140^{\circ}, +70^{\circ}$ $170^{\circ}, +72^{\circ}$. Shower well marked.
124	Nov. 19 — Dec. 15	123	84	N 19, 20	Heis
125	Nov. 23-26	103	32	174, 175	S. & Z.
	Nov. 26 — Dec. 30	100	33	G ₁	G. & H.
	Dec. 1-15	112	39	M 9	Heis
126	Dec. 9	154	26	182	S. & Z.
127	Dec. 9-21	108	63	179, 180, 184?	S. & Z.
128	Dec. 12	180	53	183	S. & Z.
129 (7)	Dec. 23	157	64	187	S. & Z.
				? G ₂	G. & H. } Possibly commencement of No. (Jan. 6.)

Supplementary Radiants.

130	Aug. 1-31	337	-10	Z 2
131	Aug. 3-30	68	46	F G
132	Aug. 3-15	55	26	R G 1

Heis	{ A southern radiant in the list Heis and Neumayer; observ in England 9-12 Aug. 1871.
G. & H.	Reduced from the observations the Radcliffe Observatory at C ford in 1870-71. The Radian also observed simultaneously.
G. & H.	

In making or reducing meteor observations, note on a single night, or on two or three consecutive evenings, it is always best to map the results *at once*, and either to endeavour to determine any new radiant, or to correct the position of old-established ones; making use of this catalogue as a guide, rather than as an end. There being doubtless a tendency for particular meteor-showers to appear most strongly marked on certain special dates, it will thus be possible to determine the position of their radiant points more accurately than they are frequently at present known. Observations specially directed towards the supposed position of a radiant will also best show the shorter tracks, which are best calculated to determine the precise position of the radiant point of any particular meteor-shower: and the characteristic features of speed or duration, brightness, colour, and of the attendant sparks or streak of meteors belonging to different showers should at the same time be very carefully recorded, and considered in distinguishing the radiant points from which they probably diverged. The radiant V, and probably also T G (No. 78), seems to have appeared somewhat prominently only during the last two or three years; whilst the neighbouring radiant T 1 (No. 67), formerly a prominent feature, especially during the August period, and giving meteors considerably less rapid in their flight than the Perseids, have been less noticeable. Those meteor-showers, at present most clearly marked and contemporaneous with the greater 7-12th August period, are V; T G (78); N 12, 13; E 1 (90); B 3; H (77); B 4 (68); T 1 (67); and in mapping the meteors at that period it will be well to bear those radiants in mind whilst attempting to fix with any degree of precision the true radiant centre (probably in itself not a fixed or precise one) of the Perseids themselves. The series of well-marked and nearly contemporaneous meteor-showers from July to September, with radiant centres some 15° - 20° around, is near α *Cephei*, including E 1; E 2; B 1, and B 4 of Greg and Herschel; B 3, B 4, and B 5 of Heis, and mostly corroborated by the Italian observers, are deserving of more study, whether as to precise duration or exact position of radiant centres and connexions with each other; or as appertaining to a single multiple radiant, or to several distinct centres of radiation.

R. P. G.

Observations of Meteor Showers, supposed to be connected with Biela's Comet. By Prof. A. S. Herschel, F.R.A.S.

In a recent publication by Dr. Weiss* on the lately discovered connexion between the appearances of meteoric showers and the orbits of certain comets, a suggestion of some importance to observers of shooting stars is offered, to which the present year

* *Beiträge zur Kenntniss der Sternschnuppen*; Vienna Acad. Sitzungsbericht, vol. lvii. 1868.